Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

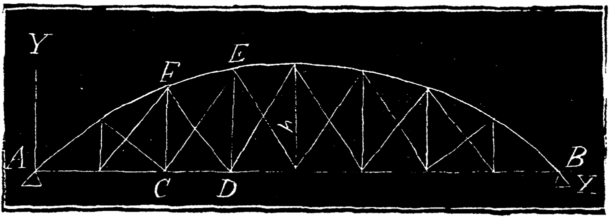
Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PROBLEM.—*By* S. W. SALMON, *Mount Olive*, N. J.—To find the greatest strain on the braces and counter-braces of a truss, produced by the passage over it of a load of uniform weight (q) per unit of length, and of length (l) equal to the length of the truss.



Let the load pass from A to B along the lower chord. Let $S=$ the strain on any brace produced by the passage of the load; H, the horizontal component of the force producing the strain; and ϕ the angle which the brace makes with the horizontal. Then

$$S=\frac{H}{\cos\phi}.$$

Take any panel $F\,C\,D\,E$. Let $A\,C=a$, $A\,D=b$, $CF=y'$, $DE=y''$, $H'=$ horizontal force at F, and $H''=$ horizontal force at E. Then $H=H'-H''$. When a part of the load of length x has passed on the chord, the reaction of the abutment at B is

$$\frac{q\,x^2}{2\,l}.$$

Three different expressions may be obtained for H. 1st, when $x<a$; 2d, when $x>a$ and $<b$, and 3d. when $x>b$. The 1st and 3d expressions have no *maximum* value. In the 2d case, by taking the moments around D we find

$$H''=\frac{q\,(l-b)x^2}{2\,l\,y''};$$

taking the moments around C, we find

$$H'=\frac{q}{y'}\left(a\,x-\frac{a\,x^2}{2\,l}-\frac{a^2}{2}\right).$$

Hence $H=H'-H''$

$$=\frac{q}{y'}\left(a\,x-\frac{a\,x^2}{2\,l}-\frac{a^2}{2}\right)-\frac{q(l-b)x^2}{2\,l\,y''}. \quad \ldots\ldots \quad (1)$$

Put $u=\dfrac{1}{y'}\left(a\,x-\dfrac{a\,x^2}{2\,l}-\dfrac{a^2}{2}\right)-\dfrac{(l-b)x^2}{2\,l\,y''}=$ a maximum.

Differentiating, $\frac{d\,u}{a\,x} = \frac{a}{y'} - \frac{a\,x}{l\,y'} - \frac{(l-b)x}{l\,y''} = 0.$

$$\therefore x = \frac{a\,l\,y''}{a\,y'' + (l-b)y'};$$

$$\frac{d^2u}{dx^2} = -\frac{a}{l\,y'} - \frac{l-b}{l\,y''},$$

which, being negative, indicates a maximum.

Substituting the above value of x in (1) we find the max. value of H

$$= \frac{q\,a^2}{2}\left(\frac{(l-a)y'' - (l-b)y'}{a\,y'\,y'' + (l-b)y'^2}\right) \quad . \; . \; . \; . \; . \; . \quad (2)$$

$\therefore$ the max. value of S

$$= \frac{q\,a^2}{2\cos\phi}\left(\frac{(l-a)y'' - (l-b)y'}{a\,y'\,y'' + (l-b)y'^2}\right).$$

If the top chord be straight, $y' = y'' = h$, and

$$S = \frac{q\,a^2}{2\,h\cos\phi}\left(\frac{b-a}{l-(b-a)}\right).$$

Let y' and y'' be ordinates of a parabola whose axis is vertical. The equation of a parabola referred to rectangular co-ordinates, A being the origin, and h the ordinate of its highest point, is

$$y = \frac{4h}{l^2}(l\,x - x^2) \;\therefore\; y' = \frac{4h}{l^2}(l\,a - a^2) \text{ and } y'' = \frac{4h}{l^2}(l\,b - b^2).$$

Substituting these values of y' and y'' in (2)

$$H = \frac{q\,l^2}{8\,h}\left(\frac{b-a}{l+b-a}\right)$$

which is constant if $(b-a)$ be constant, that is, if the panels be of equal length.

$$\therefore S = \frac{q\,l^2}{8\,h\cos\phi}\left(\frac{l-a}{l+b-a}\right).$$

If the truss sustains also a load uniformly distributed along the lower chord, then, when the upper chord is straight,

$$S = \frac{q\,a^2}{2\,h\cos\phi}\left(\frac{b-a}{l-b+a}\right) + \frac{p}{2\,h\cos\phi}[(l\,b - b^2) - (l\,a - a^2)]$$

where p = the weight per unit of length of the uniform load.